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Review Article

Load Dynamics, Recovery and Adaptation for Better Sporting Events

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Abstract

International result-oriented performance in sports requires systematic scientific training. A proper pedagogical approach is required for systematic loading of the athletes in order to record-breaking performance. The performance of an athlete largely depends upon a progressive training load for a relatively long period of time. The degree of mechanical tension, subcellular damage, and metabolic stress can all play a role in exercise-induced muscle adaptations. The process of adaptation largely depended upon the ratio of load and recovery stimulus. Thus the load dynamics and proper adaptation is reflected in the achievement of an athlete. The present research review-based article discussed systematically the procedure of training load, importance of recovery, and adaptation of load.

Keywords: Load, Recovery, adaptation and Sports.

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INTODUCTION

Better performance in global sports scenario every athlete has to undergo scientific preparation through systematic training which induces adaptations in the muscle, and metabolic, cardiovascular and neurological systems [1, 2]. The training load is a procedure to upsets the homeostasis through external stimuli and able to create dynamic internal state of equilibrium. The dynamic load adaptations are associated with changes in performance, such as a delayed onset of fatigue or an increase maximum volume of oxygen consumption or in power output. This scientific approach of training can be reduced to a simple dose-response relationship. This relationship between the physiological stresses associated with the load of exercise training ("dose") and the training adaptations ("response") [1]. It is difficult to impede the ability to derive accurate cause and-effect relationships between the training an athlete does and the resultant changes in performance. The fact that there is often disagreement between the perceptions of training load of the coaches compared with that of the athletes [3, 4].

The training impulse (TRIMP) method which monitoring the heart rate during training as a direct marker of training intensity [5]. This method uses the duration of exercise, exercise heart rate, resting heart and maximum heart rate to calculate a training impulse, or TRIMP. New technology using global positioning system (GPS) offers innovative ways to measure the covering distance and speed in a training session [6]. Due to the advancement of science and technology, the accuracy of these techniques has improved considerably so that the margin of error in case of moderate intensity exercise is minimized. Mobile ergometers are now available which enable the power output of the cyclist to be measured while they are riding their own bicycle during training and competition [7]. However, during sports characterized by short duration, high intensity exercise, the margin of error is much higher [8].

The process of training management and effective planning is long, starting with initial efforts and mistakes, leading to scientific-based planning that began to develop during the 19th century.

Developing or training physical skills has existed, though it is a basic method in the beginning, from ancient times; was used to prepare for the Olympic Games or for military purposes. The first systematic training was probably applied by the Greek athlete Milon, who used a systematic approach to planning from the 6th century BC. He decided on a training cycle by carrying a bull on his back each day until the animal reached maturity. From the middle of the 19th century on the subject of human muscle development, these scientific results were published in the then-famous philosophical journal. At the beginning of the 19th and 20th centuries, the first studies of human fatigue during work and exercise emerged. Modern scientific ideas from the middle of the 20th century formed the basis for training. It started with coaching training in the 1950s and early 1960s when coaches realized that focusing on an important competition was more effective than preparing athletes for a year-round competition program as athletes could not withstand the heavy training load they were under periodization. The roots and concept of periodic origins come from Hans Selye's model, known as General Adaptation Syndrome, which first came into use in the sports community in the late 1950's. Selye identified the sources of biological stress and referred to it as eustress, which shows the potential for muscle gain and growth, and as stress, which is a stress that can lead to injury, disease, and tissue necrosis [9, 10].

Working capacity of an individual deals with ergonomics. Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimise human well-being and overall system performance (definition International Ergonomics Association (IEA) [11]. Within this discipline or profession, physical ergonomics is regarded as one of the domains of specialization, beside organizational ergonomics, and cognitive ergonomics.

BACKGROUND

Sports performance has many natural features through exercise training, recovery, health, nutrition, mental skills and acquisition skills as important factors in athletic preparation [12]. Systematic training prepares the athlete for his or her athletic needs to develop physical and athletic skills. Well-planned training loads promote structural adaptation and metabolic flexibility that support training outcomes such as improved physical performance, injury and disease, and improved mental and physical health. Relaxation or 'pouring out' may be defined as a significant reduction in the burden of training from normal. Decreased training load can be entirely (no training) or relative (such as a decrease in percentage from normal load). Long periods of complete rest result in a reduction and a decrease in physical strength [13].

Mathematical modeling and data analysis have helped trainers, sports science and sports medicine practitioners better understand the relationship-response capacity of top Australian athletes. Significant findings support previous anecdotal evidence of effective planning and monitoring of individual training response [12]. The availability of consistent training increases the athlete's ability to work on both the team and each sport [14].

There is an increased risk of illness and / or injury when reloading after a fixed, or random release time if the volume, intensity of 4 and frequency of training is faster than the athlete's ability to adapt to training stress.

The time required to return to full training load is equal to the length of the reduced load and the amount of training completed during the dump [13].

At the individual level in the real world system, it is important to understand the context of the loading and unloading training for each sport and athlete. Unfortunately, there are no strict and fast rules, or formulas that can accurately describe training or predict performance outcomes due to the wide variety of individual athletic qualifications. Therefore, the purpose of this article is to highlight the factors to consider when an athlete returns to training from a planned break or from an illness / injury [15].

Potential effects on the human body, the framework presented is helpful. This framework separates external and internal exposure. The person at work (outside) is responsible for the work environment (job requirements, work environment) and work methods (work tasks to be performed). This results in the acceptance of a person's body shape and movement, as well as certain external forces in the human body. In addition, exposure to posture, movement and force leads to exposure to internal energy in body structures and higher levels of energy costs (i.e., internal exposure). Mechanical and physical responses occur in the short term (i.e. critical responses). Musculoskeletal disorders are among the most likely long-term consequences following critical responses. Musculoskeletal disorders are among the most likely long-term consequences following critical responses. The answers also depend on the strength of each activity (including body size, strength, and condition) as shown in Figure-1 [11, 16].

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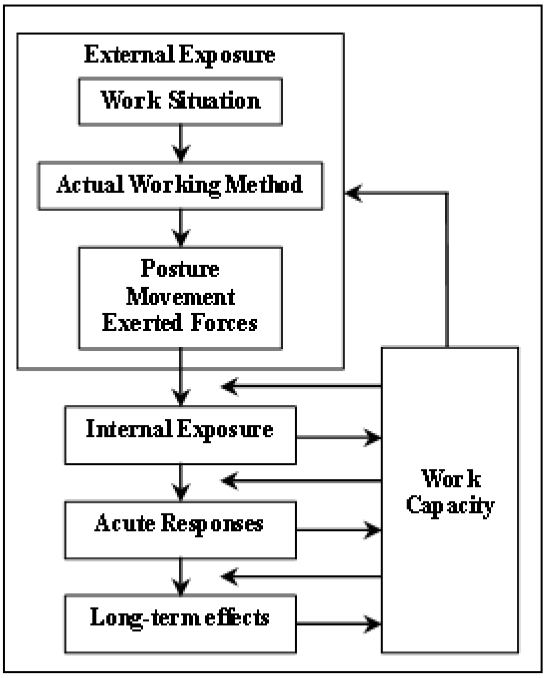

Figure 1: The exposure to physical loads and is short term and long term effects

In the last few decades' sports has become a competitive, technologically advanced industry [17]. Athletes have to deal with overcrowding calendars and face increasing pressure to stay competitive [18]. As a result, athletes of all levels and their coaching staff are constantly aiming to improve efficiency. Although there are a number of factors that can contribute, the main factor that athletes focus on is their training methods. Training and competitive responsibility trigger a series of homeostatic responses and conditions in the human body [19-21]. An important aspect of training theory is the use of this biological process to improve resilience and ultimately improve performance [22]. In addition, the main goal of rehabilitation is to improve load-bearing capacity and this has been discussed in literature in relation to tendinopathy [23] and cartilage repair [24]. There is also good evidence of stress management to prevent illness and over-training of athletes.

Misleading training responsibilities in line with the full competition calendar may have an impact on the lives of athletes [25-27].The balance between external load and tissue capacity plays an important role in injury [28] and although there are various internal and external factors [29] involved in injury, there is evidence to suggest that load management is a major risk factor for injury [30].

Training Load

The achievement of high levels of athletic performance is due to the proper use of a complex training process, which should promote the development of features related to physical fitness, technical, tactical, and mental fitness,, simultaneously and in an integrated manner [31]. The development or maintenance of fitness and the development of biomotor skills are two important factors in preparing seasonal athletes for the general and major needs they face in competition [32]. To achieve these goals, training is usually scheduled at intervals throughout the year in order to keep pace with the higher operating costs and the duration of the competition [33].

Sports Training

Sports training is a special process of preparation of sports persons based on scientific principles aimed at improving and maintaining higher performance capacity in different sports activities. It is a particular type of training designed to improve fitness and abilities to perform in a given sport. It includes strength in training, corrective and restorative exercises, conditioning and cardiovascular training. It also includes mental and psychological training and advice on nutritional values [34].

According to Harre "Sports training, based on scientific knowledge, is a pedagogical process of sports perfection through which systematic effect on psycho-physical performance ability and performance readiness aims at leading the sportsman to high and the highest performance" [35].

Training Load

Training load refers the impact of training to athlete. Without giving proper attention to the training load, the training program may result in being too stressful or too easy which result in inappropriate adaptation. Probably it is quite easy to manipulate trainings without load during high volume phases, but if trainings will move towards higher intensity the coach must design a plan that has higher load trainings alternating with lower load that favors adaptation [36].

The sport and non-sport burden (single or multiple physiological, psychological or mechanical stressors) as a stimulus that is applied to a human biological system (including subcellular elements, a single cell, tissues, one or multiple organ systems, or the individual) [37].

Training load

The cumulative amount of stress placed on an individual from a single or multiple training sessions (structured or unstructured) over a period of time.

- No effect at all – useless load
- Recovery effect – load used for recovery sessions. If used for longer periods performance decreases.
- Maintaining effect – no increases or decreases in performance can be seen
- Developing effect – training load is high enough to result improvements in performance
- Overload effect – training load is too high that results in performance decrease.

RELATED TERMINOLOGY

- **Competition load:** The cumulative amount of stress placed on an individual from a single or multiple competitions over a period of time, including stress imposed directly by exertion in a single sport or competition and indirectly by factors such as the frequency or saturation of events, the duration of the season or the number of days of the competition, and travel associated with competition.
- **Absolute Load:** Load applied to the biological system from training, competition and non-sport activities, irrespective of rate of load application, history of loading or fitness level.
- **Relative load:** Load applied to the biological system from training, competition and non-sport activities, taking into account the rate of load application, history of loading or fitness level.
- **Repetitive load:** Repeated, sequential application of a load to a biological system, characterised by a lack of variation in type, intensity, duration, or frequency. The load may or may not allow for adequate recovery between single load applications.
- **Acute Load:** Absolute load that is applied over a shorter period of time (e.g. days). It is recognised that this period may vary, but for the purposes of this consensus a standard of 1 week or less to define acute load has been adopted, as this is the most commonly used practical measure of acute load as defined in the literature [45].
- **Chronic Load:** Absolute load that is applied over a longer period of time (e.g. weeks or months). It is recognised that this period may vary, but for the purposes of this consensus a standard of 4 weeks or longer to define chronic load has been adopted, as this is the most commonly used practical measure of chronic load as defined in the literature [45].
- **Overload:** Overload occurs when the balance between external load and internal load is altered so that the body's adaptive capacity is inadequate, resulting in manifestations of altered performance and injury and/or illness. There may be an absolute overload, in which even if the body is well conditioned the load is too high. There may also be relative overload, in which the load is normal but the body's capacity is diminished (*e.g.*, running sprints with a hamstring injury).

Recovery

Both training load and competitive load elevates sports performance. In long term training protocol, the magnitude or quantum of load gradually increased which lead to improve performance. Beginners are adapted training load faster than elite performers. An athlete unable to adapted higher load unless the proper means are considered to accelerate the process of recovery [38].

Load and recovery plays a vital role for adaptation process. The recovery process can de divided into three phases.

Phase-I.

- In this phase the exercise load and recovery process going on simultaneously.
- It depends on the re-synthesis of ATP, CP, Glycogen as a result of neutralization of lactic acid.
- In case of long duration of activities this phase plays an important role.
- This phase depends upon the functional capacity and efficiency of different system and organs of the body.

Phase-II.

- This phase takes place at the end of the training sessions and end with the restoration of homeostasis.
- The duration of this phase depends upon the condition of an athlete, in general from few minutes to 2 to 3 hours.
- Deep breathing and isotonic drinks is highly recommended for normalize the respiratory system and hydration.

Phase-III

- This phase of recovery last from many hours to several days.
- The recovery is facilitates through anabolic process.
- The enzymes and the protein which is depleted during workout re synthesis in this phase.

The best recovery strategy includes best muscle recovery, a best brain recovery, and a best overall holistic recovery and most are relatively inexpensive. Many recovery strategies simply require a foundational understanding of human biology and exploiting the natural recovery strategies we as humans have evolved to have.

- **Sleep**: The most effective recovery strategy that is free at our disposal is sleep. It is faceted and multi-functional. Sleep is divided into two critical types, and each is critically important for holistic recovery [39-42].

➢ **Non-Rapid Eye Movement (NREM) Sleep:** NREM sleep is the original performance-enhancing "drug." Eighty-five percent of total sleep time consists of NREM sleep. The deepest stage of NREM sleep is also anabolic; meaning muscle, tissue, and energy building. The only way to rescue testosterone levels to baseline levels was through restoring nightly sleep amounts to the individual's "set point."

➢ **Rapid Eye Movement (REM) Sleep:** REM sleep is the state of sleep where dreaming takes place. REM sleeps is important to reduced ability to learn new information and regulate mood. Reaction time is also impacted.

- ***Hydration:*** Hydration is also what stabilizes the function of all organs of our bodies beyond just our kidneys and adrenals. Hydration is most important for stabilizing brain function. Thus, there is a reason why in the face of heat exhaustion, a loss of focus, attention, and ability to speak are three primary symptoms and why in the face of heat stroke, loss of consciousness is common. Athletes must pay particular attention to hydration status. Dynamic changes in adrenal tone leading up to or during the stress of intense training and competition require more fluid balance within the body and lead to greater fluid loss.

- ***Stretching & mobility esercise:*** Another effective recovery strategy that can be free but also cost-effective is stretching. Dynamic and static stretching can also facilitate muscle recovery post-exercise. The mechanism of action as to how mobility and stretching improve both physical and cognitive performance and accelerates both physical and cognitive recovery is simple: increased blood flow. Blood, as we know, carries many nutrients and essential biological factors to our organs, muscles, and brain, and the speed at which blood flows into these organs, muscles, and brain to expedite recovery can be accelerated through dynamic and static stretching.

- ***Cold immersion***: The mechanism of action is similar to that provided by mobility and stretching: overall augmentation of blood flow through rapid periods of reduced blood flow. A groundbreaking study has also found that cold immersion therapy can help to stabilize the immune system in fighting off infection. The physiological reaction is a survival response resulting in immediate shunting of blood to organs and muscles. Thus, after three minutes of cold exposure, overall blood flow is immediately augmented to naturally re-warm the body. This results in overall muscle recovery [43].

- ***Supplements***: The golden rule is that nutritional supplementation should come first and foremost through natural foods. An effective recovery strategy involves nutritional supplementation.

- **Creatine:** Creatine is an essential source of energy produced by our cells. Creatine is necessary for all-out high- intensity exercise. Natural creatine reserves are depleted within a minute of high-intensity exercise. However, creatine is also the rate-limiting and backbone of providing cellular energy in general in the form of ATP.

- **Magnesium:** Magnesium is also an essential biological factor. Athletes and high-performers are also oftentimes magnesium-deficient due to daily work demands. Magnesium supplementation at night ranging from 250 - 350 mg has been shown to alter sleep architecture possibly promoting sleep consolidation and more recovery sleep.

Types of Training Load

A variety of factors affect the body’s response to training load. Excessive training may place the athlete at risk for injury, illness and decreased performance. In some cases, undertraining for the expected demands of activity and/or competition may also leave an athlete susceptible to injury and decreased performance. As per the demand of training and competition and as a result of it the rate at which disturbance take place in physiological functions of the body, the load is mainly divided into two parts: 1.External load 2.Internal load.

1. **External Load**

External determine through the number of jump, total weight lifted, running speed and so on. It can be measure externally. The athlete has the capabilities to tackle the factors that imposed on him or her. Any external stimulus applied to the athlete that is measured independently of their internal characteristics [44].

The factors are as follows,

- Performance pressure.
- Distance, Time and Weight.
- Training goals.
- Determinants.

2. **Internal load**

Internal load can be considered as physiological and psychological demands or stress put on a player and be measure through the respective variables. Load measurable by assessing internal response factors within the biological system, which may be physiological, psychological, or other (44), such as;

- Maximum oxygen consumption.
- Heart rates.
- Lactic acid deposition.
- Training status.
- Genetics.
- Psychological status

Judgment of Training Load

The following parameters are generally used to assess the training load after any training session**.**

- Body weight.
- Heart rates.
- Training intensity.
- Training volume.
- Glucose and fatty acid.
- ATP and CP.
- Hormone.
- Quantity of sweat.
- Loss of concentration.
- Colour of the skin.
- Movement of the player.
- Quantity of sweat secretion.

Component of Load

Exceeding the body's physical ability to handle these loads results in pain and physical injury, which can be either acute or chronic? But from the ergonomic point of view, we need concepts and methods to identify what exactly makes physical loading a risk.

To make this possible, we adopt the view that:

Physical Loading = posture × forces × time

Body posture requires that the muscles of the body work diligently to maintain posture, which is a form of internal loading. The position factor includes how internal energy is distributed to different parts of the body .External loading occurs due to weight management, e.g. by pushing, pulling, lifting, pressing or dragging something. In general, when power is calculated as part of a load, we are more focused on external loading. In some biomechanical analyzes, the weights of parts of the human body are also sometimes considered a burden, especially if gravity influences the chosen shape [46]. The various factors or components of load are discussed below:

1. **Movement Quality**

Movement quality is the result of energy, flexibility and communication combined. We are exposing movement throughout our lives, every day. A great mover saves energy and often takes the most effective path to achieve a goal. The movement quality is an independent feature that cannot be measured precisely and accurately. When the right movement is performed by an athlete it directly affects the training load. In any type of technical process and quality movement techniques complete perfection becomes an important aspect of the training stress. By increasing the weight, the level of the load in the training movement may gradually increase. The quality movement looks good even to an inexperienced viewer. Grace and ease of movement are the manifestations of mobility, flexibility, speed, strength, balance, and communication. A good posture plays a very vital role to maintain the quality of movement which is cost efficient in terms of energy.

2. **Exercise Type**

Sports training concern with different kinds of movement, which can be developed through graded scientific exercises. Each sporting events have some specific movement demands upon which the type of exercises is depended. Different types of exercises put stress on specific muscle groups which are playing the predominant role in particular sports skills. These exercises have different effect on the performance of an individual as per the nature and demand sporting activity. The exercises are classified into three parts:

I. General exercises
II. Specific exercises
III. Competitive exercises

General exercises deals with the general physical fitness and improvement of general psycho-physiological consideration of an athlete. Specific exercises related with the sports specific skill demands and the development of those components only. The exercises which are required during competition are major concern with the competitive exercises.

3. Intensity

Intensity is related with the application of force in respect of time. The intensity is represented in degree or rate at which work done. It is further depended upon two factors, such as,

A. **Intensity of Stimulus**: It deals with the speed of work done or time taken for single movement.
B. **Density of Stimulus**: It is the ratio between load and recovery or the rest intervals between two work outs.

4. Volume

The load volume may be defined as total work done in one training session. The load volume is also divided into two parts:

A. **Duration of Stimulus:** It may be expressed in time/ distance in a single stimulus and set of stimuli.
B. **Frequency of Stimulus:** Frequency of stimulus may be defined as the number of repetitions in one set of exercises.

Adaptation of Training Load

Adaptation is defined as the adjustment of physical and psychological functional systems to the training load. Familiarity with the load, it results in an improvement in performance capacity. Thus, a sports person is able to increase his or her performance due to the adaptation process. The process of adaptation requires that the athlete maintain a routine of training. When a sports person is exposed to a new and unfamiliar load in a systematic way the adaptation process will be accelerated. When an athlete participates in any sports for a regular basis his or her particular muscle group has to act in order to the sports skill demands which facilitate the improvement performance. This continuous action of movement requires extra energy produced by carbohydrarates, proteins and fats in the human body. During sports and competition training the load is given in the form of exercise or movement as required by the body in relation to a particular sport or event. The demand process therefore creates a disruption in the Psycho-Physiological state of the human body. To overcome this problem all the structural and functional components work together to restore normal bodily functions. Continuous exercise / movement actions lead to increased tolerance because adapting to external conditions increases working capacity. In this way of coping training load is called adaptation.

Adaptation of load is simply a functional adjustment, but if the homeostasis is optimally disturbed repeatedly for a prolonged period then the human body responds by causing structural and metabolic changes which enables the body to tolerate load more easily. The process of adaptation is psycho physical in nature. The adaptation takes place in all systems, organs and functions which are affected by the process of tackling the training and competitive demands.

The adaptation processes are a set of motion only when the load is optimum. For attaining adaptation load must have certain minimum volume and intensity. If the load is minimum the adaptation process are not started and if the load is too much the recovery process are disturbed.

The adaptation of load is not only improving the performance capacity but also increase the load tolerance ability. The improvement of load tolerance and performance improvement does not have linear relationship [47-49].

Physiology of Adaptation of Load

High-intensity resistance training is associated with significant physiological adaptation within skeletal muscle [50] including changes in contractile and / or noncontractile muscle structures. When mechanical stress on the muscle occurs, myofibers and the extracellular matrix are disrupted, which in turn stimulates the process of protein formation [51]. Mechanical stress caused by intensive exercise can increase metabolic stress levels and promote subcellular pathways involved in protein synthesis such as the mitogen-activated protein kinase pathway, which may contribute to muscle growth resulting from exercise [52, 53]. The total number of sarcomere in parallel and the series increases which leads to an increase in fascicle length and pennation angle and, consequently, muscle hypertrophy. It has been suggested that stretching combined with over load is a very effective motivator to promote muscle growth [54, 55]. During eccentric exercise, the skeletal muscle is subjected to stretching and overloading resulting in subcellular damage to the contractile and structural elements of the skeletal muscle [56]. This subcellular damage or micro trauma creates a sequence of physiological events including the activation of advanced signaling pathways for gene expression and muscle hypertrophy [52, 57]. However, mechanotransduction (exercise induced mechanical stimulus) may be a major mechanism associated with muscle hypertrophy in healthy muscles. This is indicated by an increase in the number of sarcomeres in the absence of fiber necrosis following muscle tension caused by exercise [58]. The skeletal muscles sense mechanical information and convert this stimulus into biological chemical reactions which regulate the rate of protein synthesis. However, since eccentric reduction causes greater muscle contraction disorders than concentrated exercise, this type of exercise results in a rapid increase in sarcomeres in the series and similarly as defined in muscle cross sectional area (CSA) and pennation angle [59]. Previous studies have reported an increase in fiber length in the muscles under the constant eccentric function [60], whereas a decrease [61] or a lack of change [62] the length of the fiber is indicated in the muscles working with concentrically.

Severe muscle hypertrophy following high eccentric stiffness was also associated with greater fiber pennation angle [64]. These results suggest that mechanical stimulation caused by strenuous exercise may be a major cause of muscle hypertrophy. Hortobagyi *et al*, [62] also found that muscle mass recovery after inactivity was significantly better followed by eccentric exercise compared to concentric and isometric training, probably due to the greater mechanical stress produced during eccentric exercise [63]. Similarly, some studies have shown that high tension eccentric exercise is more effective than exercise focused on increasing body weight, with changes in histochemical factors and metabolic substrates within skeletal muscle [64].

Condition of Adaptation

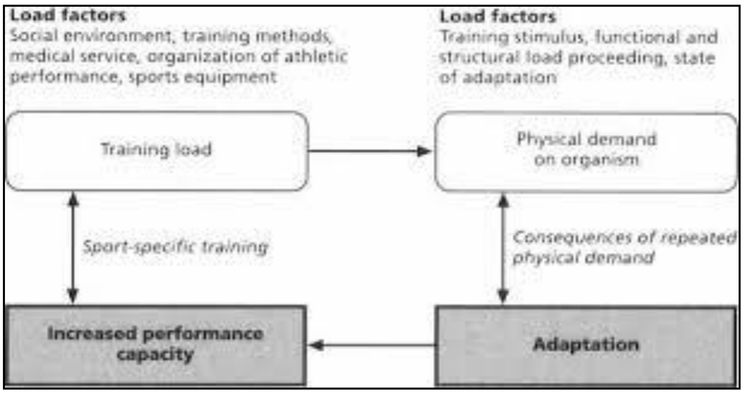

Figure 2: Adaptation and Performance [65].

Figure 2 Indicates that Training stress the puts the higher physical demands on the organism periodically. Repetition of elevated physical demands for a longer period of time able to facilitates the process of adaptation, which in turn increase the performance capacity of an athlete.

Optimum load leads to better adaptation- The load should be given as per the capacity of in individual because if the load is less adaptation will not start similarly if the load is high recovery process is delayed. There is direct relationship between the load and adaptation. This relationship is governed by certain laws which are called as laws of adaptation which are explained below;

1. Correct proportion between load and recovery- For better adaptation adequate rest is required in order the maintenance of correct proportion between load and recovery. Proper rest between training sessions must be provided. The proper ratio between work and rest intervals as hetrochronocity the various organs of the body recover at different time span, hence complete rest may be given between work out and after work out.
2. Adaptation is faster in beginners in comparison to trained sportsman - for the better adaptation in case of beginners the load should be given in linear and for the trained individual it should be given as per the individual capacity and need.
3. Variations and inhabitability of exercises leads to faster adaptation. The athlete must get the opportunity for exposure to new, innovative and inhabitable specific exercises in order to foster the process of adaptation.
4. Specific load leads to specific development – Loading procedure must be appropriate and specific in nature, depending upon the involvement of specific muscle group as per specific sports demands..
5. Correct proportion between load tolerance and training load:- In order to get the better adaptation process the proportion between load tolerance and training load must be given priority.
6. Adaptation is not permanent through training load: There should be continuity of the progressive loading procedure for maintaining the adaptation process and elevating the performance capacity.
7. For optimum adaptation maximum load is essential: Over load principle must follow for getting better adaptation. The over load must increase periodically in order to enhance the performance.
8. Adaptation is faster if perfect ratio between intensity and volume is maintained. The volume and the intensity must be inversely proportional and changeable while preparing the loading plan for an athlete.
9. Continuity in training and load factor: Training loading process is a continuous process and a matter of longer duration of time.
10. Adaptation leads in duration which is required for the structure of training load: The adaptation process may change from periodically as per the requirement and structure of training load.

11. Adaptation process must individualize matter. No two athletes are alike; the loading procedure may not be same. The loading procedure must depend upon the physiological, psychological and mechanical performance of an athlete.

CONCLUSION

High-intensity training is associated with significant physiological adaptation within skeletal muscle is major concern for sporting performance of an athlete. The procedure of loading in sports training requires scientific knowledge and insights. Continuous progressive load is prerequisite for proper adaptation, which further depended up[on ratio between load and recovery. In order to accelerate the adaptation process for better sporting performance, emphasis must be given to the psycho physiological and mechanical performance of a sportsperson.

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